

## **Carl Steefel**

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### **Education**

Ph.D. Geochemistry, 1992, Yale University, New Haven, CT.

M.S. Geology, 1982, University of Colorado, Boulder, CO.

B.A. English Literature, 1974, Washington University, St. Louis, MO.

### **Biography**

Carl Steefel obtained his B.A. in English Literature, his M.S. in Geology, and his Ph.D. in Geochemistry (1992). He has over 21 years of experience in developing models for multicomponent reactive transport in porous media and applying them to topics in reactive contaminant transport and water-rock interaction. He has developed the first routine for multicomponent nucleation and crystal size distributions in the Earth Sciences (Steefel and Van Cappellen, 1990) and the first multicomponent, multi-dimensional code for simulating water-rock interaction in non-isothermal environments (Steefel and Lasaga, 1994). He has also worked extensively in applying reactive transport modeling to natural systems, including hydrothermal, contaminant, chemical weathering, and marine environments. Recently, he has been involved in experimental studies of cation exchange (Steefel et al., 2003) and mineral dissolution and precipitation (Yang and Steefel, 2008), as well as modeling studies of field systems focused on contaminant transport, microbially-mediated biogeochemical reactions, and chemical weathering (Giambalvo et al., 2002; Steefel, 2004; Maher et al., 2009; Li et al., 2009).

### **Professional Experience**

2003-        Staff Scientist, Earth Sciences Division, Lawrence Berkeley National Laboratory  
1998-2003: Staff Scientist, Environmental Science Division, Livermore National Laboratory  
1995-1998: Assistant Professor of Geology, University of South Florida  
1995:        Senior Research Scientist, Pacific Northwest Laboratories  
1993-1995: Research Scientist, Interfacial Geochemistry Group, Pacific Northwest Laboratories  
1991-1992: Post-doctoral Associate, Mineralogisch-Petrographisches Institut, Universitat Bern  
1985-1991: Teaching and research fellowships, Yale University Department of Geology  
1985:        Project geologist, Anaconda Minerals,  
1983-1985: Staff geologist, Anaconda Minerals  
1981-1983: Geologist, Anaconda Minerals  
1979-1980: Temporary geologist, Anaconda Minerals

### **Awards**

2007        Award for outstanding contributions to basic research in the geosciences, Geosciences Research Program, Department of Energy, May 2007.  
1990        Philip M. Orville Prize for outstanding research and scholarship, Yale University  
1990        Best Student Contribution, 2nd International Symposium on the Geochemistry of the Earth's Surface and of Mineral Formation, Aix-en-Provence, France  
1989        Outstanding Mention, GSA Research Proposal  
1974        Phi Beta Kappa, Washington University

### **Selected Publications**

Li, L., C.I. Steefel, M.B. Kowalsky, A. Englert, S.S. Hubbard, 2009, Effects of physical and geochemical heterogeneities on mineral transformation and biomass accumulation during uranium bioremediation at Rifle, Colorado, *J. Contaminant Hydrology*, submitted.

- Li, L., C.I. Steefel, K.H. Williams, M.J. Wilkins, S.S. Hubbard, 2009, Mineral transformation and biomass accumulation during uranium bioremediation, Rifle, Colorado, *Environmental Science and Technology* **43**(14), 5429-5435, DOI: 10.1021/es9000016v.
- Steefel, C.I., K. Maher, 2009, Fluid-rock interaction: A reactive transport approach. *Reviews in Mineralogy and Geochemistry* **70**: 485-532, DOI: 10.2138/rmg.2009.70.11.
- Navarre-Sitchler, A., C.I. Steefel, L. Yang, L. Tomutsa, S.A. Brantley, 2009, Evolution of porosity and diffusivity associated with chemical weathering of a basalt clast. *Journal of Geophysical Research* **114**, doi:10.1029/2008JF001060.
- Maher, K., C.I. Steefel, A.F. White, and D.A. Stonestrom, 2009, The role of reaction affinity and secondary minerals in regulating chemical weathering rates at the Santa Cruz Soil Chronosequence, California, *Geochim. Cosmochim. Acta*, doi:10.1016/j.gca.2009.01.030
- Li, L., C.I. Steefel, L. Yang, 2008, Scale dependence of mineral dissolution rates within single pores and fractures, *Geochimica Cosmochimica Acta* **72**(2), 360-377.
- Yang, L., C.I. Steefel, 2008, Kaolinite dissolution and precipitation kinetics at 22°C and pH 4. *Geochimica Cosmochimica Acta* **72**(1), 99-116.
- Steefel, C.I., 2007, Geochemical kinetics and transport, in *Kinetics of Water-Rock Interaction* (eds. S.L. Brantley, J.D. Kubicki, A.F. White), Springer, New York, pp. 545-589.
- Maher, K., Steefel, C.I., and DePaolo, D.J. (2005) The mineral dissolution rate conundrum: Insights from reactive transport modeling of U isotopes and pore fluid chemistry in marine sediments. *Geochimica et Cosmochimica Acta*, submitted.
- Steefel, C.I., DePaolo, D.J., and Lichtner, P.C. (2005) Reactive transport modeling: An essential tool and a new paradigm for the Earth sciences, *Earth and Planetary Science Letters*, submitted.
- Steefel, C.I. (2004), Evaluation of the field-scale cation exchange capacity of Hanford sediments. *Proceedings of the 11<sup>th</sup> International Symposium on Water-Rock Interaction*, R.B. Wanty and R.R. Seal (eds.), Taylor and Francis Group, London, 999-1002.
- Steefel, C.I., Carroll, S., Zhao, P., and Roberts, S. (2003), Cesium migration in Hanford sediment: A multi-site cation exchange model based on laboratory transport experiments. *J. of Contaminant Hydrology* **67**, 219-246.
- Giambalvo, E.R., Steefel, C.I., Fisher, A.T., Rosenberg, N.D., and Wheat, C.G. (2002) Effect of fluid-sediment reaction on hydrothermal fluxes of major elements, eastern flank of the Juan de Fuca Ridge. *Geochimica et Cosmochimica Acta*, **66**, 1739-1757.
- Steefel, C.I. and Lichtner, P.C. (1998) Multicomponent reactive transport in discrete fractures: II. Infiltration of hyperalkaline groundwater at Maqarin, Jordan, a natural analogue site. *J. Hydrology* **209**, 200-224.
- Steefel, C.I. and MacQuarrie, K.T.B. (1996) Approaches to modeling reactive transport in porous media. In *Reactive Transport in Porous Media* (P.C. Lichtner, C.I. Steefel, and E.H. Oelkers, eds.), *Rev. Mineral.* **34**, 83-125.
- Steefel, C.I., and Lasaga, A.C. (1994) A coupled model for transport of multiple chemical species and kinetic precipitation/dissolution reactions with application to reactive flow in single phase hydrothermal systems. *American Journal of Science* **294**, 529-592.
- Steefel, C.I., and Lichtner, P.C. (1994) Diffusion and reaction in rock matrix bordering a hyperalkaline fluid-filled fracture. *Geochimica et Cosmochimica Acta* **58**, 3592-3612.
- Steefel, C.I. and Lasaga, A.C. (1992) Putting transport into water-rock interaction models. *Geology*, **20**, 680-684.
- Steefel, C.I. and Van Cappellen, P. (1990) A new kinetic approach to modeling water-rock interaction: The role of nucleation, precursors, and Ostwald ripening. *Geochimica et Cosmochimica Acta*, **54**, 2657-2677.
- Steefel, C.I. and Lasaga, A.C. (1990) The evolution of dissolution patterns: Permeability change due to coupled flow and reaction. In *Chemical Modeling of Aqueous Systems II* (eds. D. Melchior and R.L. Bassett), ACS Symposium Series No. 416, American Chemical Society, Washington, 212-225.